

investigation of a narrow hybrid zone in the classical ring species, *Ensatina eschscholtzii*, using morphological and biochemical data. Ryder et al. present chromosomal divergence in African dik-dik antelopes and its implication for managing captive vertebrates.

Community evolution is investigated by ecologists who are now *emphasizing* that historical factors impact present-day community structure. Both Roughgarden and Pacala, and Ricklefs present the taxon cycle as a general—or at least sort of general—model of community organization. The former analysis incorporates paleontological data to provide a historical context. Paleontological presentations are otherwise conspicuously absent, although Nelson's discussion of species is most comprehensible from a paleontological viewpoint. Ricklefs also suggests that comparison of traits of sister groups can elucidate factors affecting their respective diversity, a viewpoint seconded by Larson. Futuyma suggests that speciation is the means by which anagenetic change is preserved, and therefore increased speciation should be correlated with increased anagenesis, all other things being equal.

Whereas the editors were cautious about claiming to assemble a consensus view on speciation, there appears to be a consensus forming with regard to methodology. Speciation is increasingly being viewed in its historical context, and cladistic analysis is the means to present that context. Contention about the nature of species may sort itself out as we more carefully define just what we want to accomplish in any particular analysis. Sympatric speciation studies are clearly becoming more and more sophisticated. A comparison of the data generated by research programs either supporting or denying its existence aptly illustrated who is contributing to science and who isn't.

In summary, this book contains numerous thought provoking contributions that will enhance the understanding of any reader. Far from being an "advances" volume that gets dusty on the shelf, this book ought to be repeatedly consulted. Its use will no doubt stimulate further advances in evolutionary biology and systematics.—*James K. Liebherr, Department of Entomology, Comstock Hall, Cornell University, Ithaca, New York 14853-0999.*

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Invertebrate-Microbial Interactions: Ingested Fungal Enzymes in Arthropod Biology.

M. M. Martin. 1987. Cornell University Press, Ithaca and London. 148 pp., illus. \$32.50 hardbound, \$14.95 paperback.

This is the first volume in a series titled *Explorations in Chemical Ecology*, edited by T. Eisner and J. Meinwald. In the preface, author Martin describes how he evolved from organic chemist to chemical ecologist during his 20 year research career. Chapter 1 introduces the reader to the subject by lucidly explaining the chemistry of digestion of cellulose, hemicellulose and pectin. Arthropods that are known or suspected to be capable of digesting these substrates, usually with the aid of microbial enzymes, are reviewed and discussed, with a nod to the pioneering research of P. Buchner, L. Cleveland, R. Hungate and W. Trager.

Chapter 2 brings the reader to the rather complex affairs of the fungus-growing

Asian and African termites. Mutualistic *Termitomyces* fungi that are cultured in their nests provide the termites with cellulolytic enzymes and nitrogen. Martin explains each step in the research that showed how the enzymes are produced, ingested and used, and points out the need for more quantitative research to assess the roles of mutualistic fungi as well as the bacteria that live in the guts of various ages and castes of these termites. Chapters 3, 4, and 5 review the literature and describe efforts to determine how widespread is the use of ingested microbial enzymes among Arthropoda. Wood-eating siricid woodwasp and cerambycid beetle larvae utilize ingested enzymes that have been secreted by fungi in the rotting wood. However, only one of seven detritus feeders was clearly shown to use ingested microbial enzymes.

The final chapter deals with the well-known mutualism between attine ants and the fungi that they tenderly cultivate on plant tissue and other materials in their nests. In this case, Martin found that the ants, unlike the other arthropods studied, do not depend on microbial cellulases, but instead they recycle proteases that are produced by their fungi.

I detected only a few minor typos, and the photographs are a bit fuzzy, but they don't really detract from the book. A brief final comparative review and summary chapter, with recommendations for future research, would have been beneficial. I recommend this book because it is well written, thus easy to read and understand. It demonstrates the thought processes of a curious scientist as he probed a relatively unexplored research frontier of considerable complexity. It shows that nature cannot be accepted at face value but requires deep inquiry in order to achieve any understanding.—S. W. T. Batra, *Beneficial Insects Laboratory, USDA, ARS, Beltsville, Maryland.*